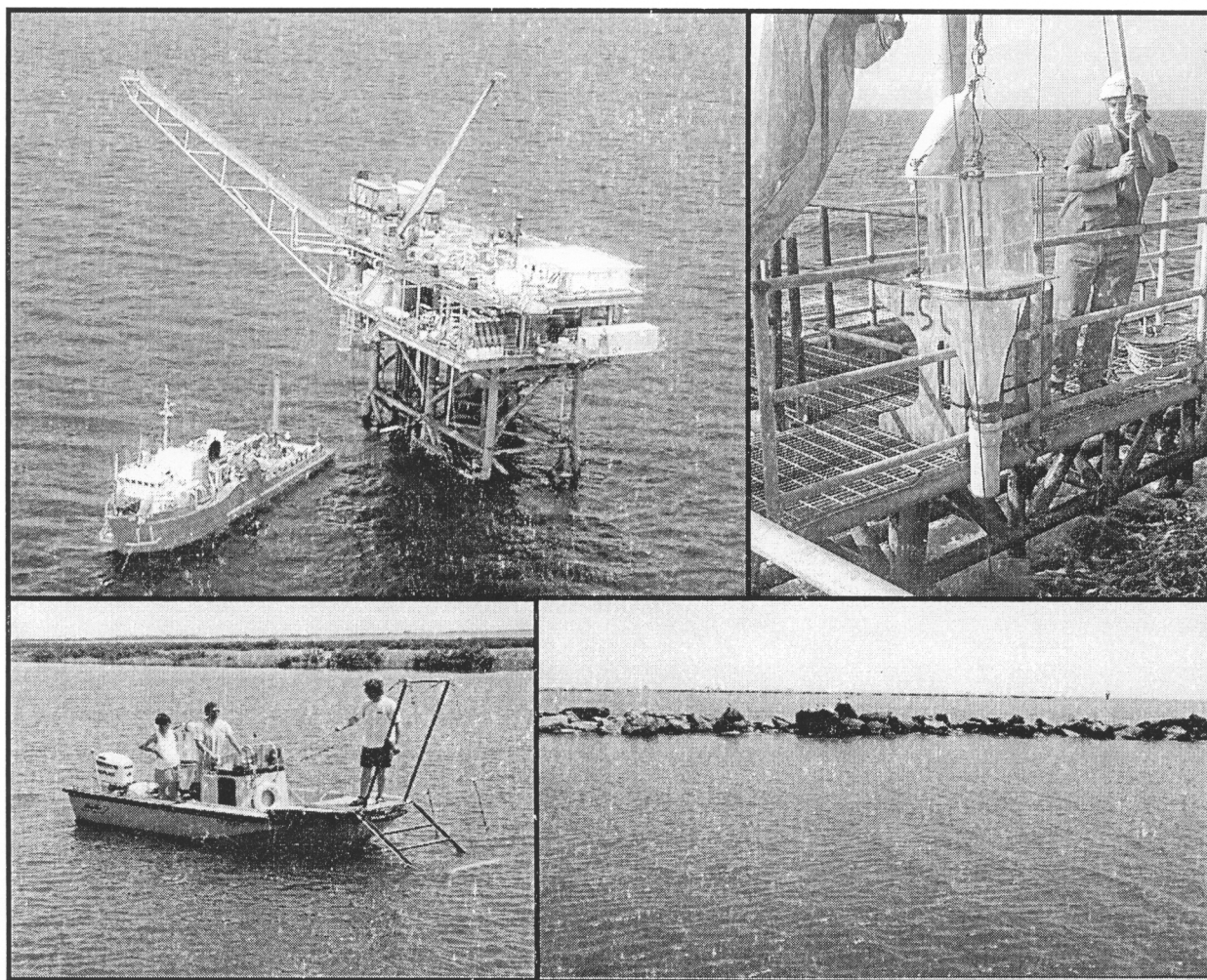


Across-Shelf Larval, Postlarval, and Juvenile Fish Collected at Offshore Oil and Gas Platforms and a Coastal Rock Jetty West of the Mississippi River Delta



Coastal Marine Institute

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As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.

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EXECUTIVE SUMMARY

The introduction and proliferation of offshore oil and gas structures in the northern Gulf has undoubtedly affected the marine ecosystem. The central and western Gulf is dominated by a mud/silt/sand bottom with only an estimated 2780 km² of natural available reef. There are approximately 4,000 oil and gas structures in the federal waters of the Gulf, accounting for approximately 11.7 km² (or 4.0%) of the total "reef" habitat in the northern Gulf. The fact that platforms represent vertical artificial substrate that extends from the bottom to the surface (photic zone), regardless of location and depth, increases their significance. Since fish populations are usually limited by available energy, recruitment, or habitat, it is important to determine if platforms: 1) provide critical habitat for early life history stages; 2) serve as new or additional spawning habitat; and 3) influence energy flow through the ecosystem by aggregating prey.

The adult fish communities around natural and artificial reefs are fairly well known and the fisheries aggregation value and enhanced biodiversity of oil and gas structures is well-recognized. Despite research efforts, however, biologists still disagree over the paradigm of whether these artificial reefs (e.g., platforms) contribute significantly to new fish production or simply attract and concentrate existing fish biomass. Since the central and western Gulf has little natural reef habitat, we believe that the contribution of artificial reefs to existing reef habitat has enhanced reef fish populations, but the overall or net impact of this augmentation is not known, especially when corrected for increased commercial and recreational fishing mortality associated with platforms.

Few studies have attempted to compare the ichthyofaunal assemblages collected at oil and gas platforms in the northcentral Gulf across wide depth zones, and the information that is available primarily concerns adult fishes and not their early life history stages. This study focused on three main objectives. The first was to respond to specific requests for more basic biological information on reef fish, e.g., larval, postlarval, and juvenile taxonomy, seasonality, lunar periodicity, distribution (vertical and across shelf), and relative abundance. Secondly, we wished to provide much needed information on the role that oil and gas platforms (hard substrate habitat) may play as nursery/recruitment grounds and/or refugia for postlarval and juvenile fish, which could contribute to fish production. Finally, as a long-term objective, we wished to evaluate the ecological significance that this artificial habitat building, which has occurred on an unprecedented scale in the northcentral Gulf, may have had on the early life history stages of fish.

Ichthyoplankton and juvenile fish assemblages were sampled at three petroleum platforms and a coastal rock jetty which served as a low salinity, artificial habitat end-member. Mobil's Green Canyon (GC) 18, which lies in about 230 m of water on the shelf slope (27°56'37"N, 91°01'45"W), was sampled monthly during new moon phases over a 2-3 night period during July 1995-June 1996. Mobil's Grand Isle (GI) 94B, which lies in approximately 60 m of water at mid-shelf (28°30'57"N, 90°07'23"W), was sampled twice monthly during new and full moon phases over a three night period during April-August 1996. Exxon's South Timbalier (ST) 54G, which lies in approximately 20 m of water on the inner shelf (28°50'01"N, 90°25'00"W), was sampled twice monthly during new and full moon periods during April-September 1997. All platforms had very similar structural complexity. The stone rubble jetties

(2-3 m depth) at the terminus of Belle Pass near Fourchon, Louisiana (N 29 03.90, W 90 13.80), were also sampled over a two night period in 1997 simultaneously with the sampling of ST 54. At the platforms, fish larvae and juveniles were collected within the platform structure using passive plankton nets and light-traps fished at depth (approximately 20 m) and near-surface, and about 20 m downstream of the platforms with a light-trap floated downstream at surface. At Belle Pass, fish larvae and juveniles were collected with light-traps deployed at the surface within two meters of the rock walls and with a bow-mounted plankton pushnet fished along the length of each jetty.

Overall family richness was highest at GC 18 (52), followed by GI 94 (43), ST 54 (42), and Belle Pass (41). At the genus level, richness was highest at Belle Pass (127), followed by GI 94 (114), ST 54 (86), and GC 18 (82). At all sites clupeiforms dominated samples, comprising 59-97% of the total catch. Reef-associated (e.g., scombrids, carangids, lutjanids, gobiids) and reef-dependent (e.g., blenniids, chaetodontids, pomacentrids) taxa were relatively rare in our collections compared to pelagic and demersal taxa. At GC 18, reef-associated and reef-dependent taxa (identified at least to the genus level) comprised 18% and 32% of the total number of fish collected with plankton nets and light-traps, respectively. At GI 94 these taxa comprised 10% of the plankton net catch and 17% of the light-trap catch. At ST 54, these fishes comprised less than 1% of the total number of fish collected with plankton nets and only 8% of the fish collected with light-traps. At the Belle Pass jetties, reef-associated and reef-dependent fishes comprised approximately 15% and 2% of plankton pushnet and light-trap catches, respectively.

Distributional differences were observed for many species within and around the platforms. Few taxa were found only in off-platform samples (4 at GC 18, 6 at GI 94, and 12 at ST 54). Some pelagic species, e.g., *Caranx crysos* and *C. hippos/latus* (GC 18) and *Euthynnus alletteratus* (GI 94 and ST54) generally had higher catch-per-unit-efforts (CPUEs) in surface waters downstream from the platforms. Several species were collected only at depth, particularly mesopelagic and benthic taxa, e.g., *Chlorophthalmus agassizi* (GC 18), *Robia legula* (GI 94), and *Ophidion robinsi* (ST 54). Other taxa predominantly found at depth included *Mugil cephalus* (GC 18), *Symphurus* spp. (GI 94), and *Ariomma* spp. (ST 54). Few differences were observed between Shannon-Weiner diversity indices calculated by gear and location, with the exception of sub-surface light-trap samples, which were significantly lower in diversity at the inner shelf and shelf slope platforms. Significant differences in mean total plankton net densities and mean total light-trap CPUEs were found between new vs. full moon phases. Plankton net densities were significantly higher during new moon sampling periods at GI 94, ST 54 and the Belle Pass jetties. Light-trap CPUEs were significantly higher during new moon periods at GI 94 and the jetties, but there was no significant difference observed at ST 54. These differences in lunar periodicities occurred in spite of the potential for competitive interference by the platforms' large ambient light-fields which could confound any lunar effect or sampling efficiency.

Between sites, the ichthyoplankton and juvenile fish assemblages sampled were relatively dissimilar, based on Schoener's Index of Similarity (0-1 scale; clupeiforms excluded), with the highest index value for any two sites being 0.45 for GI 94 and ST 54. No significant difference was observed between mean Shannon-Weiner diversity indices calculated for plankton net

samples at each site. For light-trap samples, however, diversity was lowest at GC 18, significantly higher at GI 94, and then decreased inshore. Canonical correlation analyses indicated that temperature and salinity explained most of the variation in larval abundance for some dominant taxa at the platforms, while at Belle Pass, dissolved oxygen and turbidity were also important environmental variables.

Gear comparisons demonstrated that plankton nets collected individuals from more families than light-traps at two platforms (plankton net vs. light-trap: 45 vs. 37 on the shelf slope; 40 vs. 37 on the mid-shelf; and 34 vs. 34 on the inner shelf), but only collected more taxa (genus level) than light-traps at one platform (plankton net vs. light-trap: 64 vs. 59 on the shelf slope; 83 vs. 90 on the mid-shelf; and 59 vs. 65 on the inner shelf). At the jetty, the pushnet collected more families (41 vs. 21) and taxa (85 vs. 42) than the light-trap. Results of Kolmogorov-Smirnov length-frequency comparisons of fish collected in plankton nets vs. light-traps indicated light-traps generally collected significantly larger individuals. At the jetty, greater overlap in size distributions was observed for comparisons of the pushnet and light-trap. Schoener's Similarity Indices for light-trap and plankton net samples indicated low similarity between gears at the inner shelf and shelf slope platforms (0.32-0.38), but higher similarity (0.63) at the inner shelf platform which was most dominated by clupeiforms. At the jetty, pushnet and light-trap samples had relatively high taxonomic similarity (0.61). Few significant differences were detected between Shannon-Weiner Diversity Indices for platform light-trap and plankton net samples, while at the jetty, pushnet samples had significantly higher diversity than light-trap samples.

While reef-associated and reef-dependent taxa were collected at all sites, taxonomic richness and diversity of these taxa were highest at GI 94. At this mid-shelf site, the intermediate location, depth and proximity to a high density of surrounding platforms may have created generally favorable conditions for the recruitment of reef taxa. The presence and proximity of upstream reefs and spawning habitats, therefore, may play an important role in the eventual makeup of the pre-adult assemblages. The fact that reef-dependent and reef-associated postlarvae and juveniles were rare is not surprising. Mortality rates for pelagic larvae prior to settlement approach 100%, resulting in relatively few postlarvae and juveniles surviving to settlement. Secondly, predation pressures can be high at the time of settlement with no shortage of potential predators of all sizes, as indicated by relatively high abundances of juvenile, piscivorous scombrids and synodontids. Finally, while oil and gas platforms may be suitable habitat for adults, the physical structure may not afford enough protection for juvenile fishes. Smaller reef structures have been shown to support more settlers, in part due to their greater edge effect, lower vertical relief, and greater availability of small shelter holes, i.e., porosity and rugosity. Petroleum platforms, in contrast, are larger reefs characterized as having a higher profile, less complexity, and lower porosity than natural reefs.

Other potential effects of oil and gas platforms may be an increase in available habitat for adult nesting or spawning. Since preflexion, reef-dependent larvae were often collected, it is likely that they were locally spawned upstream at either natural or artificial habitats nearby. With the limited amount of hard-substrate habitat available in the northcentral Gulf of Mexico, the addition of artificial habitats (platforms) may increase the chances of finding suitable spawning habitat. Another important consideration is the degree to which organisms associated

with the reef structure interact with pelagic species and contribute to adjacent off-reef production. Pelagic, but often structure-associated taxa, such as scombrids and carangid juveniles, are competent swimmers, highly predatory and often piscivorous. If these juveniles, which were relatively abundant in our collections, are actively feeding in association with the platforms, then they, and similar taxa could serve as important trophic links between the reef and pelagic environments. Relatively little is known about the relationship between offshore petroleum platforms and the early life history stages of fishes anywhere in the world. Our findings, therefore, represent an important first step towards this aspect of artificial reef research.

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